REMARKS

By this amendment, claim 8 has been revised and claims 1-15 are currently before the Examiner for consideration on their merits.

First, claim 8 is amended to correct the informality noted in paragraph 2 of the Office Action.

Second, Applicants respectfully request reconsideration of the rejection set forth in the outstanding Office Action dated July 18, 2006.

In that rejection, claims 1-15 are rejected under 35 U.S.C. § 102(b) based on United States Patent No. 6,413,310 to Tamatsuka. In this rejection, the Examiner contends that Tamatsuka teaches a wafer have a COP defect free layer with a thickness of 5 microns and the claimed COP defect density, citing the abstract and examples. The limitation regarding nitrogen concentration is also alleged to be present in the wafer of Tamatsuka by citing col. 4, lines 7-16. The Examiner has also taken the position that the process limitations are not given any patentable weight since there is no demonstrative evidence that the process steps impart product characteristics different from the wafer of Tamatsuka.

Applicants traverse the rejection, with the traversal set out below by headings corresponding to the claims being argued to be patentably distinguishable over Tamatsuka.

CLAIM 1

To review, claims 1 and 8 recites a number of limitations with regard to the base material wafer, either alone as in claim 1 or in combination with the epitaxial later of claim 8. The limitations are listed below.

1) COP defect region of a single crystal containing nitrogen at a concentration of less than 1×10^{14} atoms/cm^3, wherein said COP defect has a size of 0.1 μm or less in the highest frequency of occurrence and there exist no COP defects having a size of more than 0.2 μm.

2) Oxygen precipitates formed at a density of 1×10^4 counts /cm^2 or more when said base material wafer is subjected to a oxygen precipitate evaluation heat treatment; and

3) The ratio of the maximum to the minimum of BMD (oxygen precipitate) density is 3 or less in the radial direction of said base material wafer.

The rejection fails since the Examiner has not established a *prima facie* case of anticipation against claims 1 or 8. As is required when making a rejection based on 35 U.S.C. § 102(b), the applied prior art must teach each and every element of the claims, either expressly or implicitly.

In the rejection, the Examiner does not address the limitation regarding the claimed ratio of maximum to minimum of BMD density in the radial direction of the base material wafer. In addition, the Examiner has not addressed the limitation that there are no COP defects having a size of more than 0.2 μm. The Examiner cannot establish a *prima facie* case of anticipation without addressing each and every claim limitation, and the failure to do so mandates that the rejection based on 35 U.S.C. § 102(b) be withdrawn or remade with a full justification for the allegation of anticipation.

Moreover, the Examiner has no basis to conclude that claim 1 is obvious based on the teachings of Tamatsuka. The reason for this is that the Tamatsuka approach in making wafers is entirely different from that employed by the instant invention, and one of skill in the art would not be led to the invention given the teachings of Tamatsuka.

In review, the object of the invention is to provide an annealed wafer having a sufficiently greater number of BMDs in a uniform radial distribution inside the wafer and a defect free layer at the surface and to provide a silicon epitaxial wafer with an ideal or near-perfect epitaxial layer on the wafer surface. That is, the wafer of the invention pertains to a silicon annealed wafer, which has on its surface a COP defect free layer having a

thickness of 5 microns or more.

The wafer of the invention if formed by annealing a base material wafer, wherein the base material wafer includes: a COP defect region of a single crystal containing nitrogen at a concentration of less than 1×10^{14} atoms/cm^3, wherein said COP defects have a size of 0.1 microns or less in the highest frequency of occurrence and there exists no COP defects having a size of more than 0.2 microns; oxygen precipitates formed at a density of 1×10^4 counts/cm^2 or more when the base material wafer is subjected to an oxygen annealing evaluation treatment; and a ratio of maximum to minimum BMD density, which is 3 or less in the radial direction of the base material wafer.

In contrast to the base material wafer of claims 1 or 8, Tamatsuka relates to a method for producing a silicon single crystal wafer, which comprises growing a silicon single crystal ingot by the Czochralski method, slicing the ingot into a wafer, subjecting the wafer to a heat treatment at a temperature of 1100-1300 °C for 1 minute or more under a non-oxidative atmosphere, and successively subjecting the wafer to a heat treatment at a temperature of 700-1300 °C for 1 minute or more under oxidative atmosphere without cooling the wafer to a temperature lower than 700 °C, see the Disclosure of the Invention section and claim 1 of Tamatsuka.

Referring to the growing step of Tamatsuka, when the silicon single crystal ingot doped with nitrogen is grown by the Czochralski method, the nitrogen concentration doped in the silicon single crystal ingot is preferably controlled to be 1×10^{10} to 5 at 10^{15} atoms/cm^3, see col. 4, lines 7-10.

Regarding the COP defects and the layer free from COP, Tamatsuka discloses a COP density of 1.3 COPs/cm^2, with COPs having a size of 0.09 microns or more in a surface layer having a thickness of up to 5 microns from a surface. The density in the bulk portion of the wafer is larger than the density of the COPs on the surface layer. The bulk portion COPs are also

taught as having a size of 0.09 microns or more. This description can be found in col. 4, lines 25-32.

As stated above, there is no description about BMD (oxygen precipitates) in Tamatsuka, so there can be no reason to arrive at the limitation in claim 1 regarding the claimed ratio. Again, the failure of Tamatsuka to teach this limitation precludes a rejection based on 35 U.S.C. § 102(b).

Furthermore, the limitation regarding the BMDs in conjunction with the limitation regarding the density of oxygen precipitates formed in the wafer as 1×10^4 counts/cm^2 or more are essential to the invention. Having these two properties is important so that the variations of the gettering effect within the wafer surface are rendered less to avoid a possible warp of the wafer during the wafer processing due to a potential non-uniformity of the BMD density distribution within the wafer surface. The Examiner's attention is directed to page 16, line 12 to page 17, line 6, wherein it is explained the criticality of the claimed BMD limitation in combination with the density of oxygen precipitates. The importance of controlling the density of the oxygen precipitates and ratio of maximum and minimum oxygen precipitate density in the radial direction further substantiates the unobviousness of claims 1 and 8.

In addition, given that Tamatsuka employs an entirely different process than the instant invention, the Examiner cannot take the position that the missing limitation is inherently found in the wafer of Tamatsuka. As will be explained below, this limitation is a function of the manner in which the silicon single crystal is grown, and unique to the invention.

In light of the arguments above regarding a lack of a factual basis in Tamatsuka to provide the missing limitations and the improvements associated with the claim limitations, any allegation of obviousness could only be based on the hindsight reconstruction of the prior art in light of

Applicants' disclosure, and such a rejection could not be sustained upon appeal.

To reiterate, the Examiner has failed to establish a *prima facie* case of anticipation against claim 1 or claim 8, and has no basis to further reject these claims under 35 U.S.C. § 103(a). Therefore, the rejection as applied to claims 1 and 8 and their respective dependent claims 2-4 and 9-10 must be withdrawn.

CLAIMS 5 and 11

Claims 5 and 11 differ from claims 1 and 8, in that these claims are defined in terms of a process of annealing a base material wafer to have a defect free surface of 5 microns or more. The process is further defined in terms of the nitrogen concentration, Czochralski growing method, control of the temperature gradient ratio, and defined cooling times for the temperature ranges of 1200-1000 °C and 1030-920 °C.

In rejecting these claims, the Examiner contends that Tamatsuka teaches a wafer having the claimed nitrogen concentration and a defect free layer. Further, the Examiner has ignored the process limitations of claims 5 and 11 on the grounds that it has not been shown how a wafer subjected to such processing produces a wafer different from Tamatsuka.

Applicants traverse the rejection on the grounds that the process of claims 5 and 11 produce a wafer that is not taught or suggested by Tamatsuka, and this reference cannot be used to allege anticipation or even obviousness.

First, it is clear that Tamatsuka does not teach the claimed process of claims 5 and 11. In contrast to the control of the gradient and cooling temperatures, Tamatsuka employs a cooling rate for the grown silicon single crystal ingot that is 2.3 °C/minutes or more for an ingot temperature of 1150-1080 °C. Tamatsuka does not in the least teach the time control over

particular cooling range temperatures or the control of the temperature gradient as claimed.

The next question to resolve is whether it has been demonstrated that the claimed process produces a product that is materially different from the prior art wafer of Tamatsuka. In this regard, the Examiner's attention is directed to Table 1 on page 21 of the specification and its explanation as found on page 22. What this Table shows is only by practicing the invention can a wafer be made wherein the size of the COP defects is small **and** the ratio of the maximum to minimum of the BMD distribution is 3 or less. Test No. 1 has the claimed ratio, but lacks the minute size of COPs. The reason for this is that the wafer was not grown with the claimed cooling pass times.

For Test No. 2, a high nitrogen concentration in combination with pass times that are outside the claimed ranges results in an BMD density ratio within the claimed range but an unacceptable size of COP defects.

Only Test No. 3-6, each abiding by the process limitations recited in claims 5 and 11, produce the combination of defects within the claimed ranges and the claimed BMD distribution ratio. What this shows is that the processing of claims 5 and 11 is critical in achieving an improved wafer, and this wafer is not produced by the entirely different method of Tamatsuka.

Since a process that is similar to the claimed one, except for the claimed pass times and/or nitrogen concentration produces a different base material wafer, it can be concluded that a completely different process, i.e., the Tamatsuka process, would not result in a product similar to the one produced by Test Nos. 3-6. To reiterate, Tamatsuka rapidly cools at a temperature range of 1150 to 1080 °C, and there is no evidence that such a cooling would produce a silicon single crystal having a uniform BMD density in the radial direction as claimed. Since it can only be concluded that the grown crystal of Tamatsuka does not contain such a structure, a wafer cut from the ingot would also be lacking in this characteristic. Therefore, one

can conclude that the comparative evidence in the specification does demonstrate that the product produced by the process defined in claims 5 and 11 is materially different than that produced by Tamatsuka, and this patent does not disclose a wafer according to the claimed process or one that would be the same as that produced by the claimed process steps. Therefore, the rejection of claims 5 and 11 and their respective dependent claims based on Tamatsuka should be withdrawn.

Also, since Tamatsuka employs an entirely different process for wafer production, there is no basis to conclude that Tamatsuka could be modified to establish a *prima facie* case of obviousness against claims 5 and 11. As with claims 1 and 8, any such allegation could only be the hindsight reconstruction of the prior art in light of Applicants' disclosure.

SUMMARY

In summary, it is contended that the Examiner has failed to address all of the limitations of claims 1 and 8, and this failure mandates withdrawal of the rejection based on 35 U.S.C. § 102(b). Further, there is no basis to conclude obviousness given the vast difference between the processing of Tamatsuka and the invention. Similarly, the specification demonstrates that the processing employed in claims 5 and 11 is not disclosed in Tamatsuka. Further, it produces a unique base material wafer when compared to a process very similar to that claimed, and clearly produces a unique base material wafer when compared to the wafer produced by Tamatsuka's entirely different process. Thus, a *prima facie* case of anticipation or obvious is not established via the teachings of Tamatsuka.

Therefore, claims 1, 5, 8, and 11 are now in condition for allowance along with their respective dependent claims.

Accordingly, the Examiner is requested to examine this application in light of this response and pass all pending claims onto issuance.

If the Examiner believes that an interview would be helpful in expediting the allowance of this application, the Examiner is requested to telephone the undersigned at 202-835-1835.

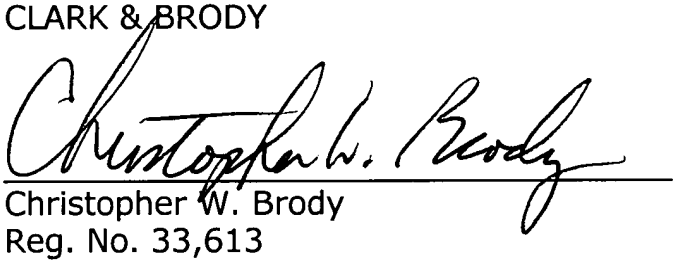
The above constitutes a complete response to all issues raised in the Office Action dated July 18, 2006.

Again, reconsideration and allowance of this application is respectfully requested.

Applicants respectfully submit that there is no fee required for this submission, however, please charge any fee deficiency or credit any overpayment to Deposit Account No. 50-1088.

Respectfully submitted,

CLARK & BRODY

By 

Christopher W. Brody
Reg. No. 33,613

Customer No. 22902
1090 Vermont Ave. NW
Suite 250
Washington, DC 20005
Telephone: 202-835-1111
Facsimile: 202-835-1755
Docket No.: 12054-0025
Date: October 13, 2006